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UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE BOARD OF PATENT APPEALS
AND INTERFERENCES

Ex parte DAVID A. PALSULICH and RONALD F. BALDNER

Appeal 2009-003244
Application 10/636,021
Technology Center 1700

Decided: September 01, 2009

Before CHUNG K. PAK, CHARLES F. WARREN, and
PETER F. KRATZ, *Administrative Patent Judges*.

PAK, *Administrative Patent Judge*.

DECISION ON APPEAL

Appellants appeal under 35 U.S.C. § 134(a) from the Examiner's decision finally rejecting claims 1 through 28 and 49 through 56 (Final Office Action, mailed Oct. 17, 2006), the only claims pending in the above-identified application. We have jurisdiction under 35 U.S.C. § 6(b).

We AFFIRM-IN-PART.

STATEMENT OF THE CASE

The subject matter on appeal is directed to a method of removing metallic films from surfaces of microfeature workpieces, e.g., semiconductor wafers (Spec. 1, para. 0001 and Claims 1, 11, 19, and 49). Details of the appealed subject matter are recited in representative claims 1, 6, 10, 11, 19, and 49 reproduced from the Claims Appendix to the Appeal Brief ("Br."), filed March 30, 2008:

1. A method of processing a microfeature workpiece, comprising:

supporting a microfeature workpiece by an unheated support in an interior of a processing chamber having a polymeric wall;

contacting a surface of the microfeature workpiece with an etchant liquid, the polymeric wall of the processing chamber being substantially non-reactive with the etchant liquid;

heating the etchant liquid by delivering radiation from a radiation source through the polymeric wall of the processing chamber to heat the etchant liquid, the polymeric wall being more transmissive of an operative wavelength range of the radiation than the etchant liquid, thereby a temperature of the etchant liquid is increased more rapidly than a temperature of the polymeric wall;

controlling the radiation source to maintain a temperature of the etchant liquid at or above a target process temperature to etch the surface of the microfeature workpiece; and

removing the etched microfeature workpiece from the processing chamber.

6. The method of claim 1 wherein a temperature of the wall of the processing chamber is no greater than the temperature of the etchant liquid when the etchant liquid is at or above the target process temperature.

10. The method of claim 1 wherein etching the surface of the microfeature workpiece yields a resultant etchant, the method further comprising determining at least one chemical property of the microfeature workpiece by chemically analyzing the resultant etchant.

11. A method of processing a microfeature workpiece comprising:

positioning a microfeature workpiece on an unheated support in an interior of a processing chamber, the processing chamber having a polymeric wall with an inner surface;

enclosing the microfeature workpiece within the interior of the processing chamber;

contacting a surface of the microfeature workpiece with an etchant liquid at a first temperature, the etchant liquid being substantially non-reactive with the inner surface of the processing chamber;

heating the etchant liquid from the first temperature to a second temperature using an infrared heat source positioned entirely outside the enclosed processing chamber and through the polymeric wall, the second temperature being higher than the first temperature and the second temperature promoting etching of a surface of the rnicrofeature workpiece, the etchant liquid being more absorptive of radiation from the infrared heat source than the polymeric wall, thereby the etchant liquid is heated more rapidly than the polymeric wall of the processing chamber; and

etching the surface of the microfeature workpiece with the etchant liquid at or above the second temperature.

19. A method of processing a microfeature workpiece, comprising:

supporting a microfeature workpiece with an unheated support in an interior of a processing chamber having a polymeric wall;

contacting a surface of the microfeature workpiece with a processing fluid;

delivering infrared radiation through the polymeric wall of the processing chamber to heat the processing fluid from a first temperature to a higher second temperature that promotes processing of the surface of the microfeature workpiece, the polymeric wall being more infrared transparent than the processing fluid, thereby the processing fluid is heated more rapidly than the polymeric wall; and

maintaining a temperature of the processing fluid at or above the second temperature for a process period to process the surface of the microfeature workpiece, a temperature of the wall of the processing chamber being no greater than the temperature of the processing fluid during the process period.

49. A method of processing a microfeature workpiece, comprising:

supporting a microfeature workpiece in a processing chamber having a wall constructed from a polymeric material;

contacting the microfeature workpiece with an etchant liquid, the polymeric wall of the processing chamber being substantially non-reactive with the etchant liquid;

increasing a temperature of the etchant liquid more rapidly than a temperature of the polymeric wall by delivering radiation to the etchant liquid from a radiation source and through the polymeric wall of the processing chamber; and

controlling the radiation source to maintain a temperature of the etchant liquid at or above a target process temperature to etch the microfeature workpiece.

The Examiner relies on the following evidence to establish unpatentability (Examiner's Answer ("Ans."), mailed June 23, 2008, 2-3):

McNeilly	US 5,762,755	Jun. 9, 1998
Tomita	US 6,054,373	Apr. 25, 2000
Yokomizo	US 6,399,517 B2	Jun. 4, 2002

Appellants request review of the following grounds of rejection set forth by the Examiner (Br. 7 and Ans. 3 and 16):

(1) Claims 1 through 9, 11 through 17, 19 through 27 and 49 through 56[1] under 35 U.S.C. § 103(a) as unpatentable over the combined disclosures of Tomita and McNeilly[2]; and

(2) Claims 10, 18, and 28 under 35 U.S.C. § 103(a) as unpatentable over the combined disclosures of Tomita and Yokomizo.

In traversing the Examiner's § 103 rejections, Appellants contend that one of ordinary skill in the art would not have been led to employ the polymeric material taught by McNeilly as part of the wafer cleaning chamber in the wafer cleaning process of type suggested by Tomita (App. Br. 8-12 and Reply Brief ("Reply Br"), filed September 10, 2008, 1-3). Appellants also contend that such a combination would not result in the claimed invention since McNeilly does not teach a wafer cleaning chamber made with a polymeric material alone (App. Br. 12). Further, Appellants separately argue the limitations of claims 6 and 49 (App. Br. 13-14). According to Appellants, the collective teachings of Tomita and McNeilly

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[1] The Examiner inadvertently left out finally rejected claims 50 through 56 in the statement of rejection set forth in the Answer. As is apparent from page 8 of the Appeal Brief and page 21 of the Examiner's Answer, the rejection of claims 50 through 56 is maintained.

[2] With respect to the first ground of rejection, Appellants have grouped the claims on appeal (Br. 8) as follows:

Group I. Claims 1-5, 8, 9, 11-13, 16, and 17;
Group II. Claims 6, 7, 14, 15, and 19-27; and
Group III. Claims 49-56.

Accordingly, for the purpose of this rejection, we limit our discussion to claims 1, 6, and 49 pursuant to the requirements of 37 C.F.R. § 41.37(c)(1)(vii).

do not teach or suggest the temperature of a polymeric wall of the processing chamber relative to the temperature of an etchant liquid (*id*). Finally, Appellants contend that Tomita and Yokomizo do not teach or suggest employing a processing chamber having a polymeric wall (App. Br. 15).

ISSUES AND CONCLUSIONS

Have Appellants shown reversible error in the Examiner's determination that one of ordinary skill in the art, armed with the knowledge taught by McNeilly, would have been led to employ a polymeric wall in forming the wafer cleaning and etching chamber of the type suggested by Tomita? On this record, we answer this question in the negative.

Have Appellants shown reversible error in the Examiner's determination that the collective teachings of Tomita and McNeilly would have suggested the limitation "a temperature of the wall of the processing chamber is no greater than the temperature of the etchant liquid when the etchant liquid is at or above the target process temperature" recited in claim 6? On this record, we answer this question in the negative.

Have Appellants shown reversible error in the Examiner's determination that the collective teachings of Tomita and McNeilly would have suggested the limitation "increasing a temperature of the etchant liquid more rapidly than a temperature of the polymeric wall by delivering radiation to the etchant liquid from a radiation source and through the polymeric wall of the processing chamber" recited in claim 49? On this record, we answer this question in the negative.

Have Appellants shown reversible error in the Examiner's determination that the collective teachings of Tomita and Yokomizo would

have led one of ordinary skill in the art to employ a polymeric wall as part of Tomita's wafer cleaning and etching chamber? On this record, we answer this question in the affirmative.

FINDINGS OF FACT ("FF")

1. The Examiner finds, and Appellants do not dispute that:

> Tomita discloses a method of processing a microfeature workpiece, comprising: supporting a microfeature workpiece (23) by an unheated support (22) in an interior of a processing chamber (21) (column 7, lines 57-61 ; Figure 5); contacting a surface of the microfeature workpiece (23) with an etchant liquid (column 7, lines 65-67; column 8, lines 1-2); heating the etchant liquid by delivering radiation from a radiation source (24) through the wall of the processing chamber to heat the etchant liquid (column 4, lines 18-22); controlling the radiation source to maintain a temperature of the etchant liquid at or above a target process temperature to etch the surface of the microfeature workpiece (column 8, lines 3-9). Although Tomita does not expressly disclose the step of removing the etched microfeature workpiece (23) from the processing chamber (21), this step is inherently present in the process. [(*Compare* Ans. 3 *with* App. Br. 8-12 and Reply Br. 1-4)]

2. Tomita teaches (col. 5, ll. 49-65) that:

> In the case of cleaning silicon substrates, the chemical agent has a boiling point of 200^{o} C. or

> higher. Preferably, the boiling point is 300° C. or higher.
>
> …
>
> In the present invention, for example, sulfuric acid, phosphoric acid, and a chemical liquid obtained by adding fluoric acid to these may be used.
>
> The purpose of adding fluoric acid is to remove a natural oxide film formed on the silicon substrate by water and oxygen diffused in the chemical liquid during cleaning. The concentration of fluoric acid added in the chemical liquid is, for example, about 0.1% or less.
>
> The highest treatment temperature in the case of the chemical agent is about 290° C. to 350° C. for sulfuric acid and fluoric-acid-added sulfuric acid and 213° C. for fluoric-acid-added phosphoric acid.

3. Tomita teaches (col. 7, l. 57 to col. 8, l. 9) that:

> The treatment apparatus according to the third embodiment is characterized in that an external infrared heater 24 directly heats a silicon substrate 23 held in a quart beaker 21 by a quart holder 22. The beaker 21 is filled with a chemical liquid.
>
> In the third embodiment, the silicon substrate 23 is selectively heated by infrared rays and the chemical liquid is heated by heat conduction from the silicon substrate 23.
>
> With such a configuration, although the temperature in the silicon substrate 23 rises as a result of infrared heating, the surface of the silicon substrate 23 is cooled by the chemical liquid, so that the temperature at the surface is lower than that in the substrate.
>
> Consequently, by controlling the output of the infrared heater 23 and the flow rate of the chemical

> agent suitably, heating can be done so that the surface temperature of the silicon substrate 23 may be lower than the boiling point of the chemical liquid and the internal temperature of the silicon substrate 23 may be higher than the boiling point of the chemical liquid.

4. McNeilly teaches a vapor phase HF/H2O etching and/or cleaning of a semiconductor wafer in which the wafer supported by a wafer support ring within a chamber having a window assembly is heated by a radiation source which passes through the window (col. 10, ll. 23-50).

5. McNeilly teaches (col. 12, ll. 37-59) that:

> An important element of the apparatus is window assembly 9. Assembly 9 comprises upper window 10. and lower window 8. A two window assembly is used to assure strength and to allow lower window 8 to be formed from a corrosion resistant material. Highly corrosive materials such as HF vapor used for wafer etching require the use of a window material which will not degrade. Additionally, any material used in window assembly 9 must necessarily allow the desired UV and IR wavelengths to pass.
>
> We have found it is most desirable to use as lower window 8 an amorphous copolymer material described in detail in U.S. Pat. No. 4,754,009, the entire disclosure of which is incorporated herein by reference, which material is sold under the trademark Teflon® AF by DuPont Polymer Products Department, Wilmington, Del. This material exhibits the necessary stability and radiation passing characteristics required in the present apparatus and process. A window thickness of about ¼ inch is preferred. As upper window 10, a ½ inch thick fused quartz available from General Electrics quartz products division

> (GE124), about 7 ½ inches in diameter is preferred. Dynasil 5000 synthetic fused quartz can also be used.

6. McNeilly teaches that the fused quartz window may be coated with Teflon® FEP resin to protect the quartz from HF, chlorine and the like (col. 13, ll. 8-21).

7. McNeilly emphasizes the importance of the window materials being impervious to the corrosive etchants used and being essentially transparent to UV and IR radiation at the wavelength typically used for heating and etching (col. 13, ll. 22-31).

8. McNeilly exemplifies employing UV light source at low power (225 to 250° C.) and high power (325 to 350° C.) to carry out the wafer etching (col. 7, ll. 19-23 and col. 8, ll. 16-22).

9. Appellants also acknowledge at page 2 of the Reply Brief that Teflon ® AF2400 (without any cooling means) has an upper use temperature of 300°C.

10. The Examiner acknowledges that Yokomizo and Tomita do not teach or suggest employing a processing chamber having a polymeric wall (Ans. 8 and 23).

PRINCIPLES OF LAW

It is well settled that the United States Patent and Trademark Office (PTO) is obligated to give claim terms their broadest reasonable interpretation, taking into account any enlightenment by way of definitions or otherwise found in the specification. *In re ICON Health and Fitness, Inc.*, 496 F.3d 1374, 1378-79 (Fed. Cir. 2007) ("[T]he PTO must give claims their

broadest reasonable construction consistent with the specification. Therefore, we look to the specification to see if it provides a definition for claim terms, but otherwise apply a broad interpretation.") (Citation omitted); *In re Bigio*, 381 F.3d 1320, 1324 (Fed. Cir. 2004) ("[T]he PTO gives a disputed claim term its broadest reasonable interpretation during patent prosecution."). The appropriate starting point for claim construction "is always with the language of the asserted claim itself." *Comark Commc'ns, Inc. v. Harris Corp.*, 156 F.3d 1182, 1186 (Fed. Cir. 1998).

This longstanding broadest reasonable interpretation principle is based on the notion that "during patent prosecution when claims can be amended, ambiguities should be recognized, scope and breadth of language explored, and clarification imposed." *In re Zletz*, 893 F.2d 319, 321 (Fed. Cir. 1989). That is, a patent applicant has the opportunity and responsibility to remove any ambiguity in claim term meaning by amending the application. "Only in this way can uncertainties of claim scope be removed, as much as possible, during the administrative process." *Zletz*, 893 F.2d at 322. "[A]s applicants may amend claims to narrow their scope, a broad construction during prosecution creates no unfairness to the applicant or patentee." *ICON Health*, 496 F.3d at 1378-79.

Under 35 U.S.C. § 103, the factual inquiry into obviousness requires a determination of: (1) the scope and content of the prior art; (2) the differences between the claimed subject matter and the prior art; (3) the level of ordinary skill in the art; and (4) secondary considerations, if any. *Graham v. John Deere Co.*, 383 U.S. 1, 17-18 (1966).

As stated in *KSR Int'l Co., v. Teleflex, Inc.*, 550 U.S. 398, 418 (2007):

> [A]nalysis [of whether the subject matter of a claim would have been prima facie obvious] need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ.

KSR also instructs that:

> When there is a design need or market pressure to solve a problem and there are a finite number of identified, predictable solutions, a person of ordinary skill has good reason to pursue the known options within his or her technical grasp. If this leads to the anticipated success, it is likely the product . . . of ordinary skill and common sense.

Id. at 421.

KSR explains

> When a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one. If a person of ordinary skill can implement a predictable variation, § 103 likely bars its patentability.

Id. at 417.

"The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results." *Id.* at 415-16..

All of the disclosures in a prior art reference, including non-preferred embodiments, "must be evaluated for what they fairly teach one of ordinary skill in the art." *In re Boe*, 355 F.2d 961, 965 (CCPA 1966); *See also Merck*

& Co. v. Biocraft Labs., Inc., 874 F.2d 804, 807 (Fed. Cir. 1989) (quoting *In re Lamberti*, 545 F.2d 747, 750 (CCPA 1976) ("[T]he fact that a specific [embodiment] is taught to be preferred is not controlling, since all disclosures of the prior art, including unpreferred embodiments, must be considered."); *In re Bozek*, 416 F.2d 1385, 1390, (CCPA 1969) ("[A] reference disclosure must be evaluated for all that it fairly [teaches] and not only for what is indicated as preferred.").

On appeal to this Board, Appellants must show that the Examiner reversibly erred in finally rejecting the claims. *Cf. In re Kahn*, 441 F.3d 977, 985-986 (Fed. Cir. 2006); *see also* 37 C.F.R. § 41.37(c)(1)(vii).

ANALYSES

Claims 1 through 5, 8, 9, 11 through 13, 16 and 17:

There is no dispute that Tomita teaches or would have suggested the microfeature workpiece (e.g., a silicon substrate) processing method recited in claims 1 through 5, 8, 9, 11 through 13, 16, and 17, except for employing the claimed processing chamber having a polymeric wall. Appellants contend that one of ordinary skill in the art would not have been led to employ the claimed processing chamber having a polymeric wall in the method taught by Tomita. We do not agree.

As indicated *supra*, Tomita teaches heating a microfeature workpiece in an etchant liquid-filled processing chamber made of quartz to at least 200° C. or higher with a radiation source. Tomita teaches that any etching agent having a boiling point of 200° C. or higher may be used to treat the microfeature workpiece at a temperature below the boiling point of the etchant liquid. Tomita emphasizes the importance of including fluoric acid

(HF) as part of the etchant liquid in removing a natural oxide film formed on a silicon substrate and exemplifies sulfuric acid, fluoric-acid-added sulfuric acid, and fluoric-acid-added phosphoric acid as its etching agent. Tomita then goes on to teach (col. 5, ll. 61-65) that:

> The highest treatment temperature in the case of the chemical agent is about 290^{o} C. to 350^{o} C. for sulfuric acid and fluoric-acid-added sulfuric acid and 213^{o} C. for fluoric-acid-added phosphoric acid.

Although Tomita does not mention employing a quartz processing chamber having a polymeric wall as required by the claims, McNeilly teaches a vapor phase HF/H_2O etching or cleaning of a semiconductor wafer (microfeature workpiece) in a chamber. McNeilly, like Tomita, heats the wafer (microfeature workpiece) held within the chamber via a radiation source (UV and IR radiation). According to McNeilly, its chamber has upper and lower windows and the UV or IR radiation passing through the upper and lower windows heats the wafer. McNeilly teaches the importance of constructing the lower window with materials impervious to the corrosive etchants used and transparent to UV and IR radiation at the wavelengths typically used for heating and etching. McNeilly exemplifies the lower window made with Teflon® AF (polymer) impervious to the corrosive etchants and teaches protecting the quartz with a polymer when HF is used as an etchant. Appellants acknowledge that it was known that Teflon® AF (polymer) can withstand a temperature as high as 300^{o}C. McNeilly also exemplifies employing UV light source at high power (325 to 350^{o} C) with a chamber having the above polymeric window.

Given the above teachings, we concur with the Examiner that one of ordinary skill in the art would have been led to employ the polymeric material (Teflon® AF) taught by McNeilly as a radiation source window or an internal wall of the microfeature workpiece processing quartz chamber taught by Tomita, with a reasonable expectation of successfully protecting Tomita's quartz chamber or quartz window portion from HF containing etchants and successfully heating the microfeature workpiece in the etching chamber with a radiation source. This is especially compelling in Tomita's cleaning and etching method involving the use of fluoric-acid-added phosphoric acid since the polymeric material (Teflon® AF) impervious to such HF etchant taught by McNeilly also permits the passage of UV and IR radiation for heating the microfeature workpiece at a temperature of 325 to 350° C.

Appellants contend one of ordinary skill in the art would not have been led to employ the polymeric material taught by McNeilly in Tomita's quartz chamber since it restricts the use of Tomita's chamber. In that regard, Appellants refer to Tomita's teaching that the highest treatment temperature can be 290° C to 350° C when sulfuric acid is used. However, the fact remains that the sulfuric acid treatment referred to is just one of the preferred embodiments taught by Tomita. Tomita also teaches another preferred embodiment in which the highest treatment temperature used is 213° C, when fluoric-acid-added phosphoric acid is employed. Tomita further teaches the importance of using fluoric acid (HF) to etch a natural oxide film formed on a wafer. According to McNeilly, however, fluoric acid (HF) is corrosive to the quartz window. McNeilly teaches that its polymeric material used for its interior window protects the quartz window from the

HF containing etchant and allows the passage of a radiation source. McNeilly also teaches that its polymeric material can be used with a radiation source (UV light source) at high power (325 to 350^{o} C). Appellants also acknowledge that the polymeric material taught by McNeilly can withstand a temperature up to 300^{o} C.

Thus, one of ordinary skill in the art looking at the collective teachings of Tomita and McNeilly would have been led to employ the polymeric material taught by McNeilly for at least the fluoric-acid-added phosphoric acid treatment taught by Tomita as a radiation window wall or an interior wall of Tomita's quartz chamber to protect the quartz chamber or its radiation source quartz window from the HF containing etchant during the heating and etching of the microfeature workpiece therein.

Appellants contend that the employment of the polymeric material taught by McNeilly in Tomita's chamber would not result in the claimed processing chamber having a polymeric wall. According to Appellants, the processing chamber suggested by Tomita and McNeilly is not entirely made of a polymeric material. However, the plain language of the claims does not require that the chamber be entirely made with a polymer material. Rather, the claimed phrase "processing chamber having a polymeric wall," as broadly construed, includes either the polymeric window wall defining a portion of the entire wall structure of the quartz chamber or the polymeric interior wall of the quartz chamber suggested by the collective teachings of Tomita and McNeilly.

It follows that Appellants have not identified any reversible error in the Examiner's determination that one of ordinary skill in the art, armed with the knowledge of the effect of a HF containing etchant and a radiation

heating source with respect to the certain polymeric materials taught by McNeilly, would have been led to employ such polymeric material in forming the wafer cleaning and etching chamber of the type suggested in Tomita.

Claims 6, 7, 14, 15, 19 through 27, and 49 through 56:

Claim 6 requires "a temperature of the wall of the processing chamber is no greater than the temperature of the etchant liquid when the etchant liquid is at or above the target process temperature." Claims 49 requires, *inter alia*, "increasing a temperature of the etchant liquid more rapidly than a temperature of the polymeric wall by delivering radiation to the etchant liquid from a radiation source and through the polymeric wall of the processing chamber." Appellants contend that Tomita and McNeilly do not teach or would not have suggested the above limitations recited in claims 6 and 49. We do not agree.

As indicated *supra*, both Tomita and McNeilly teach using a radiation source to heat the microfeature workpiece in the chamber. According to McNeilly, its polymeric and quartz windows permit the passage of UV and IR radiation in order to heat the microfeature workpiece to a temperature as high as 350^{o} C. The microfeature workpiece, according to Tomita, in turn, heats the etchant liquid which is inside of the chamber wall. In other words, the chamber wall is not heated until the etchant liquid is sufficiently heated so that it can transfer its heat to the chamber wall. Implicit in these teachings is that the temperature of the wall of the processing chamber is no greater than the temperature of the etchant liquid when the etchant liquid is at or above the target process temperature as required by claim 6 and that the

temperature of the etchant liquid increases more rapidly than the temperature of the polymeric wall via radiation passing through the polymeric wall of the processing chamber containing the etchant liquid and the microfeature workpiece as required by claim 49.

It follows that Appellants again have not identified any reversible error in the Examiner's determination that the collective teachings of Tomita and McNeilly would have suggested the limitations in question recited in claims 6 and 49.

Claims 10, 20, and 28:

The Examiner acknowledges that Tomita and Yokomizo do not teach or suggest a processing chamber having a polymeric wall. The Examiner refers to McNeilly for teaching a processing chamber having a polymeric wall. However, the Examiner has not relied on McNeilly in rejecting claims 10, 20 and 28 on appeal. The Examiner has not included McNeilly in the statement of rejection against claims 10, 20, and 28 set forth in the Final Office action or the Answer. Accordingly, Appellants have shown reversible error in the Examiner's rejection of claims 10, 20, and 28.

CONCLUSION

In view of the foregoing, we sustain the rejection of the claims on appeal, except for claims 10, 20, and 28, under 35 U.S.C. § 103(a).

Accordingly, the decision of the Examiner is affirmed-in-part.

No time period for taking any subsequent action in connection with this appeal maybe extended under 37 C.F.R. § 1.136(a)(1)(v).

AFFIRMED-IN-PART

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